FIBEROPTIC EXAMINATION OF THE UPPER AIRWAY

I. NOSE
A. Septum
1. Septal deviation; evaluation of repair
2. Bony spurs, protrusion, ridging
3. Perforation
B. Mucosa
1. Color
2. Exudate
C. Nasal Turbinates
1. Clefting
   a. Both horizontal and sagittal clefting can occur
   b. Horizontal or sagittal clefting of the middle turbinate can look like a polyp
2. Post-op evaluation of turbinectomy
3. Polypoid changes
D. Superior Meatus, Sphenethmoidal Recess
1. Sphenoid ostia
2. Posterior ethmoid ostia
3. Ethmoidectomy
E. Middle Meatus
1. Frontal sinus ostium
2. Maxillary sinus ostium
3. Anterior ethmoid ostia
F. Inferior Meatus
1. Nasolacrimal duct
2. Surgically created antral windows
G. Polyps
1. Manipulation necessary to distinguish polypoidal degeneration of a turbinate from polyps which are entering the nose from the sinuses.
2. Most polyps originate from the ethmoids, but they can come from any of the sinuses.

II. NASOPHARYNX, SUPERIOR PHARYNX
A. Torus Tubarius, Eustachian Orifice
1. Obstruction, dysfunction
2. Cysts
B. Rösenmuller’s Fossa
1. Vertical cleft between posterior lip of torus and adenoidal pad
2. Many pharyngeal malignancies originate here
C. Adenoid
1. Primary lymph node, first line of defense for inflammation involving the nasal airway
2. May impinge on torus tubarius – opening of eustachian tube
3. Adenoidectomy may damage torus
4. Hypertrophy may partially or totally block nasal airway
D. Palate
E. Pharyngeal Wall
1. Spasm of constrictor muscles
2. Osteophytes from vertebral bodies may cause obstruction
3. Hypertrophy of lymphoid tissue from chronic inflammation produces a “cobblestoned” appearance

III. INFERIOR PHARYNX, HYPOPHARYNX, LARYNX
A. Posterior tongue; lingual tonsils
1. Hypertrophy may result in a sensation of globus
B. Vallecule
C. Epiglottis
1. Inflammation, irritation
2. Hypervascularity, edema (angioedema)
D. Aryepiglottic folds
E. Arytenoids
F. False Cords
G. Vocal cords (true cords)
   1. Appearance
   2. Mobility (paralysis?)
      a. Quiet breathing
      b. Deep inspiration
      c. Panting
      d. Phonation ("eeeee")
   3. Glottic aperture
      a. Mucus bridging
      b. Midline
   4. Vocal cord trauma, hyperkeratosis, malignancies, inflammatory granulomata, polyps, Reinke's edema, nodules, ulcerations, granulomatous extensions, papillomas
   5. Vocal cord dysfunction syndromes

TECHNIQUE OF EXAMINATION

I. INDICATIONS
   A. Direct
      1. Nasal obstruction, particularly if unilateral (adenoidal hypertrophy; tumors; small nasal passages; polyps; deviated septum; etc.)
      2. Headaches, facial pain (septal spur, severe congestion, etc.)
      3. Epistaxis (location of bleeding sites)
      4. Rhinorrhea, particularly if unilateral
      5. Sinusitis (identification of predisposing factors)
      6. Chronic otitis media, particularly if unilateral (adenoidal hypertrophy; torus cysts; tumors; synchiae)
      7. Regional adenopathy (inflammation, rule out malignancy)
      8. Postoperative evaluation of sinus surgery, other nasal surgery (patency of ostomies)
      9. Dysphasia, globus (lingual tonsil hypertrophy; pharyngeal constriction; etc.)
      10. Hoarseness, voice disorders (vocal cord lesion; paralysis)
      11. Laryngeal wheezing, stridor (vocal cord dysfunction; other laryngeal disorders)
   B. Relative-any patient, with any complaint, referable to the upper airway

II. ROUTINE SPECULUM EXAM

III. DECONGESTION, ANESTHESIA
   A. The patient is asked to blow nose; saline irrigation may be necessary
   B. Decongestion- oxymetazoline (Afrin)
   C. Anesthetic-lidocaine 4% (Astra) in atomizer
   D. Optional - Viscous lidocaine 2 % applied to tip of scope for lubrication or applied to head of turbinate via Q-tip

IV. SUGGESTED EXAM SEQUENCE
   A. Nasal vestibule, septum, nasal floor, inferior turbinate, mucosa
   B. Superior portions of the anterior nose
   C. Nasal roof (go over the middle turbinate, flex tip upwards)
      1. Cribriform plate
   D. Nasal floor, move posteriorly, view choana
   E. Nasopharynx
      1. Adenoidal pad
      2. Torus-both sides ("eeeee" or "kay,kay,kay,kay" for function)
      3. Rosenmüller's fossa
   F. Patient asked to nose breath, scope directed inferiorly
      1. Lateral pharyngeal walls
      2. Soft palate
      3. Posterior pharyngeal wall
   G. Oropharynx
      1. Posterior tongue, lingual tonsils
      2. Vallecula
      3. Glossal, epiglottic, lateral glottic folds
   H. Pharynx
      1. Patient asked not to swallow, asked to breathe quietly
      2. Scope advanced along posterior pharyngeal wall, over the epiglottis
         a. Pyriform sinuses
         b. Arytenoids
         c. False vocal cords
         d. True vocal cords – “eeeee” for adduction; quiet/deep breathing; panting
I. Return to position anterior to choana; flex tip upwards, view:
   1. Sphenoethmoidal recess
   2. Superior (supreme) turbinate
   3. Introitus, ostia of sphenoid sinus; ostia of posterior ethmoids
J. Middle turbinate (rotate laterally, flex tip upwards)
   1. Polyps
   2. Maxillary sinus ostium
K. Withdraw scope, check contralateral nose

V. CLEANING UP – High Level Disinfectant
   A. Wipe with soap and water
   B. Cidex OPA etc. as a disinfectant per manufacturer’s instruction
   C. Rinse clean with water
   D. Wipe with 70% isopropyl alcohol
   E. Dry
   F. Leak Test

IMPORTANT UPPER AIRWAY STRUCTURES

I. NASAL FOSSA
   A. Septum
   B. Turbinates
      1. Inferior
      2. Middle
      3. Superior
   C. Sinus orifices
      1. Frontal
      2. Anterior ethmoidal
      3. Maxillary
      4. Posterior ethmoidal
   D. Nasolacrimal duct

II. NASOPHARYNX, SUPERIOR OROPHARYNX
   A. Eustachian orifice, torus tubarius
   B. Rosenmüller’s fossa
   C. Adenoid
   D. Pharyngeal wall, related structures
   E. Soft palate

III. INFERIOR OROPHARYNX, HYPOPHARYNX
   A. Posterior tongue
   B. Lingual tonsil
   C. Pharyngeal wall, related structures
   D. Vallecule
   E. Piriiform sinuses
   F. Glottic structures
      1. Epiglottis
      2. Vocal cords
      3. Arytenoids, para-arytenoid structures
      4. Subglottis

Product Information

• BR Surgical, LLC 3500 Beachwood Court, Suite 107, Jacksonville, Florida 32224, (888) 642-1366 www.brsurgical.com
• Olympus Corporation, Medical Instrument Division, 4 Nevada Drive, Lake Success, New York 11042, (516) 488-3880
• Machida Boroscopes, 40 Ramland Road South Orangeburg, NY 10962 (http://www.machidascope.com/main.htm)
• Pentax, Precision Instrument Corporation, 30 Ramland Road, Orangeburg, New York 10962 www.Pentaxmedical.com
• Optim Inc., 64 Technology Park Rd, Sturbridge, Ma 01566, (800) 225-7486, (http://www.optimnet.com/medical.php)
• Rhinoscope iphone adapter, Clearwater Limited LTD, http://www.clearwaterclinical.com/clearwater
REFERENCES

Websites
2. Gary Stadtmauer: http://www.cityallergy.com

Texts

Articles
WHAT IS RHINOSCOPY?

Fiberoptic rhinopharyngolaryngoscopy (or, rhinoscopy) is a new technique for examining the nose and throat. Usual methods can only look into the front of the nose, but with the rhinoscope your doctor can examine the entire nasal passage, including the eustachian tube openings, the adenoids, the throat, and the vocal cords.

If you are being seen in the clinic for a disorder of your airways, your doctor may want to examine these important areas. Although not difficult, the procedure takes a few minutes; if the clinic is busy it may be necessary to schedule a separate appointment for the exam.

What is a rhinoscope? The rhinoscope is a small, flexible plastic tube with fiberoptics for viewing the airway. The rhinoscope can be attached to a television camera to provide a permanent record of your examination.

What happens during the exam? First, we decongest the nose with a nose spray. This is followed by a local anesthetic nose spray. As the scope enters your nose, you will feel that it’s there, but it won’t hurt. Especially if you have small nasal passages, certain parts of the nasal exam can get uncomfortable; be sure to tell the doctor if anything actually hurts. During examination of the nose, you may breathe through the nose or the mouth, but when it’s time to look at the back of the throat and the vocal cords, the doctor will ask you to breathe through the nose, and not to swallow. Swallowing at this point won’t be dangerous, but could cause an uncomfortable sensation, just as if someone were to touch the back of your throat. Sometimes the local anesthetic drips down the back of the nose and numbs the back of the throat; this is an unpleasant sensation, but it goes away in just a few minutes. If your examination has been videotaped, the doctor will review the tape with you, if you wish.

Can children be examined? Almost nothing that happens in a doctor’s office is popular with small children, and rhinoscopy is no exception. Older children put up with the procedure better than do some adults. With small children, it’s best to ask the child to sit in a parent’s lap. If the child is uncooperative and the exam is absolutely essential, sedation can be provided, but you will need to wait in the clinic until the sedative has worn off.

But I have asthma! Recently, physicians have discovered an unusual disorder of the larynx and vocal cords which mimics asthma. The easiest way to make the diagnosis is to examine the vocal cords with a rhinoscope during an actual attack.

What if something’s wrong? Many nasal disorders respond well to medication. Should we find an abnormality that is not likely to respond to medication, or if we have questions about your exam, we will refer you to an ENT specialist.
(Suggested Sequence for Examination)

FIBEROPTIC RHINOLARYNGOSCOPY

Nose, nasopharynx

Nasal vestibule, septum, nasal floor, inferior turbinate, mucosa
   Superior portions of anterior nose
   Nasal roof
   Middle turbinate
   Nasal floor to choana
   Sphenoethmoidal recess (now, or after laryngeal examination)
   Nasopharynx
      adenoidal pad
      torus-both sides
      Rosenmüller's fossa

Pharynx, larynx

Lateral and posterior pharyngeal walls, soft palate
   Posterior tongue, lingual tonsils
   Epiglottis, vallecula, aryepiglottic folds
   Arytenoids, associated cartilages, piriform sinuses
   False vocal cords, true cords, ventricles
   Transglottic look at trachea

Remaining nasal structures

Sphenoethmoidal recess
   Middle meatus

Contralateral nasal cavity
## PROCEDURE NOTE

### PATIENT:

### DATE:

### PREEXAMINATION DIAGNOSIS:

### POSTEXAMINATION DIAGNOSIS:

### PROCEDURE:
- Fiberoptic nasopharyngoscopy (CPT 92511)
- Fiberoptic nasal endoscopy (CPT 31231)
- Fiberoptic nasopharyngolaryngoscopy (CPT 31575)

### EXAMINER:

### INDICATIONS:

### DESCRIPTION OF PROCEDURE:
The patient was examined in the sitting position. Mucus was cleared from the nose, and mucosal vasoconstriction was accomplished with topical oxymetazoline (Afrin). Topical anesthesia was obtained in the nose with 4% lidocaine spray. The fiberoptiscpe was introduced into the right nostril. The septum was noted to be straight and free of defects. The mucosa was of normal color, and no exudate was present. The torus tubarius, eustachian tube orifices, Rosenmüller’s fossae, and the adenoid were normal. The sphenoethmoidal area was inspected bilaterally and was normal. The palate appeared to close properly. The lingual aspect of the epiglottis, base of tongue, and tonsils were normal. The superior portions of the piriform sinuses and postcricoid area were normal. The laryngeal aspect of the epiglottis, aryepiglottic folds, and the false cords were normal. The arytenoids and true cords were normal in appearance and mobility during quiet breathing, deep inspiration, panting, and phonation. A transglottic look at the upper trachea was normal. The endoscope was withdrawn and the left nasal passage was examined. The septum, mucosa and turbinates were also normal on this side of the nose. The procedure was concluded. No epistaxis or other complication resulted.

### VARIATIONS FROM NORMAL:

<table>
<thead>
<tr>
<th>Variation</th>
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<tbody>
<tr>
<td>septum</td>
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<td>transglottic look at upper trachea</td>
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<td>complications</td>
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PROCEDURE NOTE – FIBEROPTIC RHINOLARYNGOSCOPY

PATIENT:

DATE:

PREEXAMINATION DIAGNOSIS:

POSTEXAMINATION DIAGNOSIS:

PROCEDURE:  Fiberoptic nasopharyngoscopy (CPT 92511)
Fiberoptic nasal endoscopy (CPT 31231)
Fiberoptic nasopharyngolaryngoscopy (CPT 31575)

EXAMINER:

INDICATIONS:

Description of procedure: With the patient in the sitting position, mucus was cleared from the nose. Topical vasoconstriction was accomplished with 1% oxymetazoline spray. Topical anesthesia was obtained with 4% lidocaine spray. Both sides of the nose, as well as the upper airway, were examined. Findings were as follows:

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<thead>
<tr>
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<tbody>
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<td>transglottic look at trachea</td>
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<td>arytenoids</td>
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Complications:
Pre-Examination Diagnosis:
1. (   )
2. (   )

Post-Examination Diagnosis:
1. (   )
2. (   )

Procedure: Fiberoptic nasopharyngoscopy (CPT 92511)
Procedure: Fiberoptic nasal endoscopy (CPT 31231)
Procedure: Fiberoptic nasopharyngolaryngoscopy (CPT 31575)

Examiner: Jerald W. Koepke, M.D.

Indications: (   )

Description of the Procedure: The patient was examined in the sitting position. Mucus was cleared from the nose, and mucosal vasoconstriction was accomplished with topical 0.05% oxymetazoline. Topical anesthesia was achieved with 4% lidocaine spray. The fiberopticscope was introduced into the right nostril. The septum was (   ). The turbinates were (   ). Nasal polyps were (   ). The adenoid was (   ).

The scope was withdrawn and the left nostril was examined. The septum was (   ). The turbinates were (   ). Nasal polyps were (   ). The adenoid was (   ).

The sphenoethmoidal recess was inspected and appeared normal bilaterally. (or note abnormalities)
The torus tubarius, Eustachian tube orifices, Rösenmuller’s fossae were normal bilaterally. (or note abnormalities)

The nasopharynx was examined and appeared normal. The lingual aspect of the epiglottis, base of tongue and tonsils were normal. The superior portions of the piriform sinuses and postcricoid area were normal. The laryngeal aspect of the epiglottis, aryepiglottic folds, and false cords were normal. The arytenoids and true cords appeared normal in appearance and mobility during quiet breathing, deep inspiration, and phonation. A transglottic look at the upper trachea was normal. The endoscope was withdrawn and the procedure was terminated. The patient tolerated the procedure well without epistaxis or complications.

Jerald W. Koepke, M.D.
RHINOLARYNGOSCOPY – CPT CODES

All Scopes Are Not Created Equal

CPT contains dozens of codes to describe endoscopic procedures. Typically, an allergist will bill the following: (Note these are surgical codes since rhinoscopy is a surgical procedure. Patients may have a separate deductible which needs to be met before rhinoscopy is covered.)

92511 – Nasopharyngoscopy; diagnostic, unilateral or bilateral
31231 - Nasal endoscopy; diagnostic, unilateral or bilateral (separate procedure)
31575 - Laryngoscopy, flexible fiber-optic; diagnostic

Distinguishing among these codes can be difficult at first because they all describe diagnostic nasal endoscopies and the procedures defined by each may be performed using the same type of scope. Nevertheless, these procedures are distinct.

The difference between 92511, 31231 and 31575 depends on why the scope was done and what was examined.

92511 (CMS RVU 4.09) Nasopharyngoscopy is used when the physician introduces the flexible fiber optic endoscope through the nose and advances it into the nasopharynx to determine whether there are any fixed blockages such as a deviated septum, nasal polyps, or enlarged adenoids and tonsils. The physician may position the tip of the endoscope at the level of the hard palate and instruct the patient to perform simple maneuvers that demonstrate airway activity under conditions that promote or prevent collapse. The test may be performed to identify anatomic factors contributing to sleep disorders, stability of the upper airway and determining treatments.

31231 (CMS RVU 4.68) If you evaluate the entire nasal cavity, including where the sinuses drain, that is nasal endoscopy. Note that a diagnostic nasal endoscopy may require multiple passes to examine the middle and superior meatus, turbinates, and openings to the sinus cavities. 31231 is appropriate to report a diagnostic nasal endoscopy when doing a more detailed exam of the area extending from the nostrils to the posterior edge of the soft palate.

31575 (CMS RVU 2.99) Laryngoscopy. This code, by contrast, involves the insertion of a flexible fiberoptic scope, or nasopharyngeal laryngoscopy, through the patient’s nose or mouth to examine the interior of the larynx. This provides a better view of the upper airway than a traditional mirror exam. The allergist may perform the procedure in the office, or in some cases, at a hospitalized patient’s bedside.

Support Scopes with Indications

When performing endoscopic procedures, an allergist must clearly indicate medical necessity or risk claim rejection. In particular, the allergist, when performing laryngoscopy, must show a compelling reason for using flexible laryngoscopy as opposed to doing a simple mirror exam. In its policy statement regarding 31575, for example, the American Academy of Otolaryngology, Head and Neck Surgery states, "Flexible laryngoscopy should not be considered a routine part of the initial visit." In other words, it should not be used simply as a replacement for the mirror. The allergist might perform a flexible laryngoscopy because the scope can examine areas that are inaccessible with the mirror or because the patient cannot tolerate the mirror due to a strong gag reflex. Remember, when performing flexible laryngoscopy it is important to state why a mirror exam could not be accomplished.
Indications for flexible laryngoscopy may include:

- macroglossia prevents mirror examination
- gag reflex presents mirror examination
- trismus prevents mirror examination
- the patient is unable to cooperate to allow mirror exam due to the age or mental condition
- hoarseness, dysphasia, or aspiration are not clearly evaluated by indirect laryngoscopy
- a lesion identified by mirror needs further examination
- an anterior commissure is not completely visualized by mirror examination
- suspected aspiration cannot be evaluated by mirror only
- evaluation of the larynx and intermediate subglottic area following tracheal decannulation
- acute airway obstruction evaluation
- laryngopharyngeal reflux
- cough

Note: Not all of the above indications may prove medical necessity for all carriers. For example, flexible laryngoscopy for a patient with a gag reflex may be interpreted as a mere patient or physician convenience. Check with your individual carrier regarding this issue. Acceptable diagnoses to accompany 92511, 31231 and 31575 may vary by code and payer.

**Reporting Scopes with E/M**

Because physicians are increasingly using flexible laryngoscopy and mirror exam interchangeably, more and more carriers are bundling 31575 to any accompanying E/M service provided on the same date of service. For example, mirror exam is considered incidental to 99213 (Office or other outpatient visit for the evaluation and management of an established patient). If the allergist reports 31575 and 99213 without justifying the laryngoscopy, the carrier may reimburse only the E/M visit (99213). If documentation shows that the allergist made a medical decision to perform laryngoscopy based on patient history and exam, the carrier would more likely reimburse separately for all services.

In addition, if a scope and E/M visit are to be provided on the same date of service, modifier-25 (significant, separately identifiable evaluation and management service by the same physician on the same day of the procedure or other service) must be amended to the E/M code. Physically separating the documentation for the scope and the E/M service can be done to further differentiate the services. A separate procedure note (or, at the minimum, a separate paragraph within the patient record) should detail the reason for the scope as well as all associative findings. Separate diagnoses for the E/M and scope are not required, but, if available, they should be listed.

For example, if a patient presents with cough and hoarseness, and the physician decides to visualize the vocal cords to rule out vocal cord dysfunction vs. asthma, the patient may leave with only the diagnoses of asthma (493.x) if the exam is negative. However, cough may also be listed and tied to the laryngoscopy using modifier – 25.

Successful coding for rhinoscopy has been achieved using the following strategy. If a patient is a New Patient, (codes 99201-99205), the visit and the rhinoscopy procedure can be charged by using modifier -25 with the E/M code. This also applies when using Consultation Codes.
If the patient is an established patient, and the rhinoscopy is done because of a new diagnosis, both E/M and rhinoscopy can be charged using modifier -25 for the E/M code. As an example, a patient who is being followed for asthma comes in for a follow up visit. The patient has a new complaint—unilateral nasal obstruction, hyposmia, etc. Rhinoscopy is performed and a polyp, chronic sinusitis, etc. is noted. An E/M for the asthma visit can be charged, along with charging for the rhinoscopy, using the new diagnosis for the rhinoscopy with a -25 modifier for the visit.

Signs and/or symptoms may also be used to support either the E/M or the procedure along with the definite diagnosis for the encounter. For example, if the patient presents for cough and a scope is performed to rule out vocal cord dysfunction and it is negative, but the physician indicates the patient now has asthma, you could use both the cough and asthma diagnosis. Cough could be your diagnosis for the scope and asthma would be your diagnosis for the E/M encounter. The physician should code for the services which are provided and let the staff appeal the procedure which may be denied. The exception would be when the physician knows in advance that the carrier will not reimburse for the procedure and the E/M on the same day, then they have a choice; either do both and not be reimbursed for one, or have the patient schedule an appointment for the procedure at a later date.

If the patient has asthma and has had previous complaints of nasal symptoms, which have become worse, you are probably better off to do the asthma E/M visit, and then reschedule the patient for a separate rhinoscopy/laryngoscopy visit, at which time you will be able to deal with that complaint without the threat of losing your fee for the asthma care. The pre-existing rhinitis diagnosis might cause the rejection of the E/M charge for the asthma and related services, saying that everything done that day is in the "content of service" for the rhinoscopy. This advice is given with the caveat that unlike Medicare, interpretations by insurers may vary significantly from one area to another.

If documentation does not support billing for both the scope and an E/M service, choose the appropriate code according to the results of the endoscopic exam. If the laryngoscopy is negative it is best to report the E/M service. If the scope reveals positive findings, it is appropriate to report 31575.

**Multiple Scopes On the Same Day**

Several endoscopic procedures may be performed on the same day under certain circumstances, but the allergist must be cautious when billing such services. For example, because the flexible laryngoscope may be passed through the nose, the sinus area can be examined before the scope enters the larynx. Therefore, both a nasal endoscopy (31231) and flexible laryngoscopy (31575) may be performed, although both may not be billed. In this case, only the more extensive procedure (i.e. usually 31231-nasal endoscopy) should be reported.

*Contact your individual insurer with questions. Note that some insurers will allow a diagnosis that does not appear in their local medical review policies and may give individual consideration to unlisted diagnoses and unique circumstances.*
Match Approved Diagnoses to Scopes

Establishing medical necessity for endoscopic procedures depends largely on the attending diagnoses (es). Medicare carriers and other payers specify varying guidelines as to the diagnoses that they will accept to support 31231 and 31575 but the following represents a typical (although incomplete) list of commonly accepted ICD-9 Codes for each:

- **31231 & 92511 -Nasal endoscopy, diagnostic, unilateral or bilateral (separate procedure)**
  
  - 461.0-461.9 Acute Sinusitis
  - 471.0-471.8 Nasal Polyps
  - 473.0-473.9 Chronic Sinusitis
  - 476.0 Chronic Laryngitis
  - 478.0-478.29 Other Diseases of the Upper Respiratory Tract
  - 493.94-493.91 Asthma, Unspecified (atypical)
  - 780.50-780.57 Sleep Disturbances
  - 784.40-784.49 Voice Disturbance
  - 784.7 Epistaxis
  - 784.9 Other Symptoms Involving Head and Neck
  - 786.2 Cough
  - 470.0 Deviated septum

- **31575 -Laryngoscopy, flexible fiberoptic: diagnostic**
  
  - 464.4 Croup
  - 465.0 Acute Laryngopharyngitis
  - 472.1 Chronic Pharyngitis
  - 476.0 Chronic Laryngitis
  - 478.70-478.79 Other Diseases of the Larynx
  - 491.1 Mucopurulent Chronic Bronchitis
  - 518.81 Respiratory Failure
  - 519.1 Other Diseases of the Trachea and Bronchus
  - 780.51 Insomnia with Sleep Apnea
  - 784.1 Throat Pain
  - 784.2 Swelling, Mass, or Lump and Head and Neck
  - 784.49 Other Voice Disturbance
  - 989.5 Toxic Effects of Venom
  - 995.0 Other Anaphylactic Shock
  - 786.2 Cough
NORMAL ANATOMY OF THE UPPER AIRWAY

For convenience in the study of anatomy and pathology, the upper airway may be divided into sections (Figure 1). In adults, each nasal cavity is a channel approximately nine to ten centimeters in length from the nostril to the choana. The choana (posterior naris) separates the nasal cavity from the nasopharynx. The oropharynx, in which the palatine tonsils are located, extends from the inferior margin of the soft palate to the valleculae at the base of the tongue. The hypopharynx is located below the oropharynx at the level of the larynx. The triangular inlet of the larynx (aditus laryngis) is formed by the superior margin of the epiglottis, the aryepiglottic folds, and the arytenoid cartilages. The larynx becomes continuous with the trachea below the cricoid.

ANTERIOR NASAL STRUCTURES

The nasal cavity is divided into right and left chambers by the nasal septum, which may deviate considerably from the midline. The nasal vestibule is the most anterior and inferior portion of the nasal cavity (Figure 2). It is bounded medially and laterally by the lower lateral cartilages and extends to the inferior border of the upper lateral nasal cartilage. The vestibule is lined by skin, rather than by mucosa, which gives rise to the vibrissae, coarse nasal hairs which serve as a protective mechanism. Above the vestibule and in front of the middle meatus is the nasal atrium, and above this is the agger nasi, an area which generally contains anterior ethmoid air cells. The nasal valve is located at the junction of the vestibule and the nasal cavity. This structure, whose cross sectional area is regulated by the dilator naris muscle, provides limiting resistance to airflow. The nasal floor is formed anteriorly by the maxillary bone and posteriorly by the palatine bone. It is slightly concave and passes horizontally from the vestibule to the choana. The incisive canal is located on the anteromedial nasal floor. The nasal vault narrows superiorly to form the roof of the nose. The middle portion of the nasal roof is approximately parallel to the nasal floor, but the anterior and posterior parts slope inferiorly.
FIGURE 3. Cartilaginous and bony structures of the nasal septum. The quadrangular septal cartilage and the vomer articulate with bones of the nasal floor. The thin perpendicular plate of the ethmoid extends upward to the cribiform plate.

NASAL SEPTUM

The nasal septum consists of both cartilaginous and bony components (Figure 3), with mucous membrane overlying perichondrium or periosteum of the underlying cartilage or bone. The mobile, anterior portion of the septum is composed of a quadrangular septal cartilage resting on a ridge on the maxillary bone and articulating posteriorly with the thin, delicate bone of the perpendicular plate of the ethmoid and inferiorly with the thicker, more rigid bone of the vomer. The vomer forms the medial border of the choanae and rests on the crest of the maxillary bone anteriorly and the crest of the palatine bone posteriorly. The perpendicular plate of the ethmoid extends superiorly, attaching to the cribiform plate (lamina cribosa). A superior projection of the hard palate, the maxillary ridge (crista nasalis maxillae; nasal crest of maxilla) often forms a "T" anteriorly at the base of the septum. The lateral wings of the "T" may project into the nasal cavity and be mistaken for a septal deviation.

The septum is rarely straight in normal adults. A blow to the tip of the nose will cause telescoping, dislocation, or other types of distortion of these delicate bones and cartilages without external signs of a fractured nose. Trauma may result in a septal hematoma with separation of mucoperichondrium from the septal cartilage, resulting in a septal abscess and subsequent perforation. Other injuries may result in chronic nasal obstruction, abnormal nasal function, and change in voice quality.

TURBINATES

Three or four turbinates on each side provide filtration, heating, and cooling; and humidification of inspired air and offer resistance to air flow. The turbinates are comprised of a scroll shaped eggshell-thin bony supporting structure, called a concha, and overlying mucosa. Clefting, or segmentalization, of the turbinates may occur both horizontally and sagittally, and clefting of a middle turbinate may be difficult to distinguish from a nasal polyp on anterior examination. The space created by a turbinate and the lateral wall of the nose is called a meatus.

Inferior Turbinate and Inferior Meatus

The inferior concha is a separate bone sitting in an opening in the maxilla and resting in the lateral wall of the nasal passage. The turbinate follows the lower lateral wall of the nose in a course parallel to that of the nasal floor. In patients with deviation of the septum, the inferior turbinates are not the same size. The inferior meatus is a convenient passage for advancement of the rhinoscope to the nasopharynx. The only normal opening in the inferior meatus is the nasolacrimal duct which drains tears through a large opening in the anterior roof of the meatus (Figure 4), located about 1 cm. from the anterior margin of the turbinate. Compromise of the nasolacrimal duct can lead to tearing and acute or chronic dacryocystitis. The orifice is almost never seen by fiberoptic rhinoscopy. An opening found in the lateral wall of this location is most likely an antral window surgically placed in the inferior meatus to provide drainage for the maxillary sinus (Figure 6). It is frequently possible to pass the fiberoptic rhinoscope through an antral window in order to assess the status of the maxillary sinus mucosa.

FIGURE 4. A sagittal section of the head with the turbinates removed to demonstrate ostia of the paranasal sinuses and nasolacrimal duct.
Middle Turbinate and Middle Meatus

The middle turbinate, like the superior turbinate, is part of the ethmoid bone and is suspended from the roof of the nose rather than from the lateral wall. The anterior edge is superior and posterior to that of the inferior turbinate.

A crescent shaped shelf, the semilunar hiatus (hiatus semilunaris), is located in the middle meatus (Figure 4). The ostium of the nasofrontal duct and the anterior ethmoid ostia typically are located in the anterior and mid portions of the hiatus. Not infrequently, the nasofrontal duct will have a separate opening anterior to the semilunar hiatus. The maxillary sinuses open into the posteriorinferior portion of the hiatus. The ostium of the maxillary sinus varies in size in normals from pinpoint to several millimeters in diameter and large accessory ostia may be present; it is often possible to advance the fiberoptic rhinoscope into the maxillary sinus itself in a patient with a large ostium or a large accessory ostium. Posterior and superior to the semilunar hiatus is the ethmoid bulla (bulla ethmoidalis), a bulge containing anterior and middle ethmoid air cells.

Superior and Supreme Turbinates

The superior turbinate is a short structure obliquely located superior and posterior to the middle turbinate. The posterior ethmoid sinuses drain into the superior meatus (Figure 4). A supreme turbinate medial to the superior turbinate is occasionally noted.

SPHENOETHMOIDAL RECESS

The sphenoethmoidal recess is a relatively inaccessible region located superior, posterior, and medial to the superior turbinate. It contains the ostia of the sphenoid and posterior ethmoid sinuses. (Figure 4).

NASOPHARYNX

The torus tubarius is located on the lateral wall of the nasopharynx, defining and protecting the orifice of the tympanohyoid recess, or eustachian tube (Figure 2). Rosenmiller’s foramen is a vertical cleft, a potential space, between the posterior lip of the torus tubarius and the adenoidal pad. It is of considerable importance because many of the insidious malignancies of the pharynx have their origin in this space. The adenoid, or pharyngeal tonsil, is the first collection of lymphoid tissue downstream from the nasal passages and sinuses.

OROPHARYNX AND HYPOPATRYNX

The lingual tonsils are located on either side of the dorso of the base of the tongue anterior to the epiglotis (Figure 5). The median glossoepiglottic fold and the two lateral glossoepiglottic folds extend from the epiglotis to the base of the tongue. The valleculae are cup shaped spaces, separated by the median glossoepiglottic fold, posterior to the base of the tongue and anterior to the epiglottis. To the right and to the left of the larynx are the piriform sinuses, gutter like structures which direct food to the esophagus.

LARYNX

The framework of the larynx is formed by the thyroid, cricoid, and epiglottic cartilages and by pairs of arytenoid, corniculate, and cuneiform cartilages. The aryepiglottic folds and the arytenoids are located immediately behind the epiglottis (Figure 5). The nodular swellings located medially in the aryepiglottic folds are the corniculate cartilages which sit on top of the arytenoid cartilages. Lateral to the corniculate cartilages are the cuneiform cartilages. The aperture of the glottis (rima glottidis) is formed by the true vocal cords (vocal folds; plicae vocales) and the posterior commissure between the arytenoids. The anterior ligament of the true vocal cords is located at the anterior angle of the vocal cords. Between the true vocal cords and the false vocal cords (vestibular folds; plicae ventriculares) are the laryngeal ventricles.

The true vocal cords are anteriorly attached to the thyroid cartilage. The posterior attachment is to the vocal processes of the arytenoid cartilages. The true cords are relatively less vascular and are therefore whiter appearing than the surrounding mucosa. The strong vocal ligaments are covered by connective tissue and a thin layer of epithelium. Reinke’s space is the
potential space between the vocal ligaments and the subepithelial connective tissue layer. The mobile arytenoid cartilages move in and out with respiration and phonation.

THE PARANASAL SINUSES

Thin bony partitions separate the sinus cavities from other structures of the head. The frontal, ethmoid, and maxillary sinuses comprise three walls of the orbit, and the sphenoid sinus is posterior to the orbit. The sella turcica is superior to the sphenoid sinus; other adjacent structures include the internal carotid artery, the optic nerve, and the brain. The frontal sinus is also juxtaposed to the brain; infection could extend posteriorly into the dura and brain, inferiorly into the orbit, or anteriorly into bone and periorbit, resulting in a subperiosteal abscess (Pot's puffy tumor).

The maxillary sinuses (antra of Highmore) are the largest of the paranasal sinuses (Figure 6). The roots of the maxillary molar teeth often extend into the floor of the maxillary sinus. The floor of the sinus may extend down into the alveolar process. The ostium draining the sinus is located superiorly on the posterior medial wall of the sinus; accessory sinus ostia are not uncommonly found. Ciliary action sweeps secretions and bacteria against the force of gravity up to the small ostium and into the middle meatus.

From three to twelve ethmoid air cells comprise each side of the delicate ethmoid labyrinth, located along the medial wall of each orbit (Figures 6 and 7).

Those which have ostia emptying into the middle meatus are defined as anterior ethmoid cells and those that have ostia that empty into the superior or supreme meatus are defined as posterior. A few ethmoid cells which might drain in or superior to the ethmoid bulla would be designated by some anatomists as middle ethmoidal cells. Posterior ethmoid sinuses may also drain into the sphenoid sinus. The fovea ethmoidalis, the roof of the ethmoid sinuses, extends above the level of the cribiform plate by about 1 cm. The ethmoid labyrinth is separated from the orbit by the lamina papyracea (lamina cribrosa ethmoidalis). The middle ethmoidal air cells medially form the prominent bulge in the middle meatus called the ethmoid bulla (bulla ethmoidalis ossis ethmoidalis; ethmoid antrum). On occasion, a misplaced posterior ethmoid cell will locate in the middle turbinate, forming a concha bullosa. Anterior ethmoid cells may be found in the agger nasi and uncinate process. Ethmoid cells which have migrated into the superior roof of the maxillary sinuses are called Haller cells.

The sphenoid sinus is a posterior extension of the ethmoid labyrinth (Figures 4 and 7). It is centrally placed in the skull, and pain originating from the sinus may be referred behind the eyes, to the temples, or to the occiput. An irregularly shaped bony septum forms two or more often asymmetrical structures. Each portion of the sphenoid sinus empties into the sphenethmoidal recess via an ostium in its superior anterior wall.

If the ethmoid labyrinth is followed anteriorly and superiorly, it is evident that the frontal sinus (Figure 4),
like the sphenoid sinuses, is actually an enlarged, septated ethmoid air cell. The extent of the frontal sinus is variable. Some individuals have only a rudimentary frontal sinus; in others, the sinus may be so large that it extends out over the orbit or almost back to the temporal bone. A large frontal sinus causes the frontal bossing characteristic of some adults. The frontal sinus drains to the middle meatus via the nasofrontal duct.

**NASAL INNERVATION**

The olfactory epithelia is located on the nasal roof. Nerve fibers from the olfactory cells penetrate the cribiform plate and enter the olfactory bulb of the brain.

The other sensory nerves are largely derived from the ophthalmic and maxillary divisions of the trigeminal (V) nerve (Figure 5). The anterior and posterior ethmoid nerves and the infratrochlear nerve are branches of the ophthalmic nerve. The anterior ethmoid nerve enters through a small foramen in the anterior vault of the nose; branches innervate the anterior septum, the anterior lateral wall, and a portion of the external nose. Brances of the maxillary division of the trigeminal nerve originate in the pterygopalatine ganglion and enter the nasal cavity through the sphenopalatine foramen in the pterygopalatine fossa. The nasopalatine nerve innervates the middle and posterior septum and terminates in the incisive canal. The posterior lateral branches of the palatine nerve innervate the turbinates and meati, and the anterior superior alveolar branch of the infraorbital nerve innervates the nasal floor and the anterior portion of the inferior meatus, and the maxillary sinus. The pharyngeal nerve innervates the sphenoid sinus and the nasopharynx. A few other small sensory branches pass from the mandibular division of the fifth nerve up through the nasis into the vestibule of the nose; in the nose these form a network of nerves.

When topically anesthetizing the nose for endoscopy, it is only important to place anesthesia in the anterior vault of the nose, posterior to the inferior and middle turbinates, and in the area of the anterior septum. Anesthesia of the pharynx and larynx is not required for routine fiberoptic examination of the upper airway.
Guidelines for the Evaluation and Treatment of Laryngopharyngeal Reflux (LPR)

LPR is diagnosed with increasing frequency in our community. The criteria for this diagnosis are not precise and it is likely that over and under diagnosis is common. In an effort to establish some basis for the diagnosis and treatment of this disorder, these guidelines are provided. Those of us who are interested in evaluating and treating patients with LPR should become familiar with the literature as well as the techniques and skills of laryngeal assessment. Allergists can distinguish themselves by approaching this disorder in an evidence-based manner. Patients considered for this diagnosis should meet criteria for symptoms and laryngeal examination, and that periodic assessment include both evaluations.

LPR is the result of retrograde flow of gastric contents to the laryngopharynx, where it comes in contact with tissues of the upper aerodigestive tract. It has been reported to be present in 50% of patients who present with hoarseness. There is danger in failing to recognize LPR, while over diagnosis can lead to unnecessary treatments, costs, and missed diagnosis. However, reviews of the evaluation and management of LPR have recently been published (1), as well as guidelines for diagnosis (2, 3). Diagnosis guidelines include a reflux symptom index (RSI), and reflux finding score (RFS). Although far from absolute, these diagnostic guidelines provide some degree of objective criteria for the diagnosis of LPR, as well as a means to follow the progress of a patient with this disorder.

**Reflux Symptom Index:** in a series of patients in whom LPR was suspected clinically, the diagnosis was confirmed by 24-hour dual-probe esophageal pH monitoring (2). A series of asymptomatic controls were also given the self-administered questionnaire. The mean pre-treatment score of patients with LPR was 20 +/- 10, and improved to a mean score of 10 following treatment. Asymptomatic controls had a mean score 11.6 (95% CI 9.7-13.6). The authors conclude that an RSI score >13 is abnormal. The questionnaire administered asked the following questions:

<table>
<thead>
<tr>
<th>Within the last month, how did the following problems affect you?</th>
<th>0 = no problem;</th>
<th>5 = severe problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hoarseness or a problem with your voice</td>
<td>0</td>
<td>1</td>
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<tr>
<td>Clearing your throat</td>
<td>0</td>
<td>1</td>
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<tr>
<td>Excess throat mucus or postnasal drip</td>
<td>0</td>
<td>1</td>
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<tr>
<td>Difficulty swallowing food, liquids, or pills</td>
<td>0</td>
<td>1</td>
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<td>Coughing after you ate or after lying down</td>
<td>0</td>
<td>1</td>
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<tr>
<td>Breathing difficulties or episodes</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Troublesome or annoying cough</td>
<td>0</td>
<td>1</td>
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<tr>
<td>Sensation of something sticking in your throat or a lump in your throat</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Heartburn, chest pain, indigestion, or stomach acid coming up</td>
<td>0</td>
<td>1</td>
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**Column scores**

**TOTAL SCORE**
**Reflux Finding Score**: The same research group that developed the RSI, also investigated the validity and reliability of a RFS (3). Forty consecutive patients with a clinical diagnosis of LPR that was confirmed by dual-probe pH monitoring were enrolled. Patients were prospectively evaluated before treatment and 2, 4, and 6 months after treatment with PPI’s. Examination was by transnasal fiberoptic laryngoscopy at every visit (see Table below). Forty age-matched asymptomatic control subjects were included for study. For test-retest intraobserver reliability assessment, the RFS of the photo documented larynges was determined by a single-blinded laryngologist on two separate occasions. To evaluate interobserver reliability, the RFS of the photo documented larynges was scored by two different single-blinded laryngologists (even though this involved an ENT fellow and the professors who were training him).

The mean RFS for patients with LPR was 11.5 (+/- 5.2 SD), and improved progressively to 6.1 at 6 months of treatment. The mean RFS for the control subjects was 5.2 (95% confidence interval = 3.6-6.8). There was very high intra and interobserver reliability. **This suggests that a person with a RFS of greater than 7 has a 95% likelihood of having LPR.**

An explanation of each item is included in the manuscript and summarized below:

- **Subglottic edema.** Also called pseudosulcus vocalis, it refers to subglottic edema that extends from the anterior commissure to the posterior larynx.
- **Ventricular obliteration:** this was found in 80% of patients with LPR. Swelling of the true and false vocal cords causes this space to be poorly visualized. This finding was noticeably reversed with successful antireflux treatment.
- **Laryngeal erythema/hyperemia:** this was a relatively non-specific finding that is significantly dependent of the videoendoscopic equipment. Subtle changes were difficult to quantify.
- **True vocal fold edema:** was graded as mild if only slight swelling existed, moderate when it becomes more perceptible and severe when swelling of the cord becomes sessile. Polypoid degeneration contributes 4 points.
- **Diffuse laryngeal edema:** this is judged by the size of the airway relative to the size of the larynx.
- **Posterior commissure hypertrophy:** this was found to be a frequent finding. It was graded as mild when was there was a “mustache-like” appearance of the posterior commissure mucosa, and moderate when the posterior commissure was swollen enough to create a straight line across the back of the larynx. Severe grading was noted when there is bulging of the posterior larynx into the airway, and obstructing when a significant portion of the airway is obliterated.
- **Granuloma/granulation tissue:** patients got 2 points when this finding was present.
- **Thick endolaryngeal mucus:** patients got 2 points when this finding was present.

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<thead>
<tr>
<th>Reflux Finding Score: a score of &gt;7 is 95% predictive of LPR</th>
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<tr>
<td><strong>Physical finding</strong></td>
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<td>Subglottic edema (pseudosulcus)</td>
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<td>Ventricular obliteration</td>
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<td>Laryngeal erythema/hyperemia</td>
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<td><strong>TOTAL SCORE</strong></td>
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Direct Demonstration of Reflux:
1. 24-hour pH monitoring
2. Multichannel intraluminal impedance (MCII)

Treatment: (see reference 1 for a more complete discussion)
1. Patient Education and Behavioral Changes
   a. Dietary changes
   b. Weight loss/smoking cessation/alcohol avoidance
   c. Significant independent variable in determining response to medical therapy
2. Medical Management
   a. PPI’s: mainstay of treatment
      i. More variable response than GERD; requires more aggressive and prolonged treatment than GERD
      ii. Twice daily results in higher symptom relief
      iii. Optimal schedule is 30-60 minutes before meals
      iv. Probably need 2 to 3 months of treatment
      v. Nonresponders should undergo further studies
   b. H2-receptor antagonists: limited value in LPR
   c. Prokinetic agents: metoclopramide (Reglan) possibly helpful
   d. Sucralfate (Carafate): may be helpful in protecting injured mucosa from harmful effects of pepsin and acid
   e. Antacids: little role in LPR
3. Surgery: less helpful than GERD

References:
Rhinoscope Cleaner

Note: 2013 cost is approximately $20

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NOTE: ASSEMBLE WITH PVC CEMENT (COST $ 1.87)